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New record of *Juliomys ossitenuis* Costa, Pavan, Leite & Fagundes, 2007 (Rodentia, Sigmodontinae) in Santa Catarina state, southern Brazil

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Abstract
Juliomys ossitenuis Costa, Pavan, Leite and Fagundes, 2007 was previously known in Brazil from the Atlantic Forest of the Southeastern Region to the Dense Ombrophilous Forest and Araucaria Forest of the Southern Region. The new record from Chapecó, in Santa Catarina state, confirmed by morphological and cytogenetic analyses, extends its distribution about 300 km westwards. This is the westernmost record for the species, in a region characterized by the transition between deciduous and Araucaria forests.

Keywords
Araucaria forest, cytogenetics, Dense Ombrophilous Forest, small mammals.

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Introduction

Juliomys González, 2000 (Cricetidae, Sigmodontinae) is a genus of rodent that occurs from the states of Espírito Santo to Rio Grande do Sul (Southeastern to Southern Brazil), westward to eastern Paraguay and northeastern Argentina (Pavan and Leite 2011), reaching the southernmost portion of the Atlantic Forest (Rizzini 1997; Galindo–Leal and Câmara 2005). Individuals are commonly recognized by their small size, tail with the same length or longer than the body, brown coloration on the dorsum, and orangish on the posterior portion of the dorsum and snout (Pavan and Leite 2011).

Four species are currently recognized: *J. pictipes* (Osgood, 1933) (type locality in Argentina, Misiones, Río Paraná); *J. rimofrons* Oliveira & Bonvicino, 2002 (type locality in Brazil, Minas Gerais, Itamonte, Brejo da Lapa); *J. ossitenuis* Costa, Pavan, Leite & Fagundes, 2007 (type locality in Brazil, Minas Gerais, Parque Estadual da Serra do Brigadeiro); and the recently described *J. ximenezi* Christoff, Vieira, Oliveira, Golçalves, Valiati & Tomasi, 2016 (type locality in Brazil, Rio Grande do

Sul, Parque Nacional de Aparados da Serra, municipality of Cambará do Sul). This last one occurs in the southern portion of the Atlantic Forest, which is characterized by the subtropical Mixed Ombrophilous Forest (or Brazilian Araucaria Forest) that is still poorly known regarding the diversity of Sigmodontinae rodents.

Juliomy pictipes, *J. rimofrons* and *J. ossistenuis* have external morphology and cranial characteristics that allow their differentiation (Grazzini et al. 2015). *Juliomy ximenezi*, in turn, can be considered a cryptic species and difficult to recognize by morphological characteristics (Christoff et al. 2016). The overlap of distribution limits of the species is still poorly known, and the sympatry of *J. ossitenuis* and *J. pictipes* has already been reported in the state of São Paulo (Pavan and Leite 2011). Christoff et al. (2016) suggest that these species may also be sympatric with *J. ximenezi* throughout their distributions. In this case, karyotypic differences between species represent a powerful tool to differentiate them: *J. pictipes* (2n = 36, FN = 34), *J. rimofrons* (2n = 20, FN = 34), *J. ossitenuis* (2n = 20, FN = 36) and *J. ximenezi* (2n = 32, FN = 48).

The geographical distribution of *J. ossitenuis* was registered by Costa et al. (2007), Pavan and Leite (2011), Aguieiras et al. (2013), Grazzini et al. (2015) and Christoff et al. (2016). The species is found in semideciduous and montane forests, from Espírito Santo to Rio Grande do Sul, Southeastern and Southern Brazil. However, most of these records are in the sensu stricto portion of the Atlantic Forest, near the coastal region (Fig. 1). In this article, we expand the known distributional range of *J. ossitenuis* in approximately 300 linear km west of its nearest locality at the Reserva Biológica Estadual de Sassafrás, on the coast of Santa Catarina state (Christoff et al. 2016).

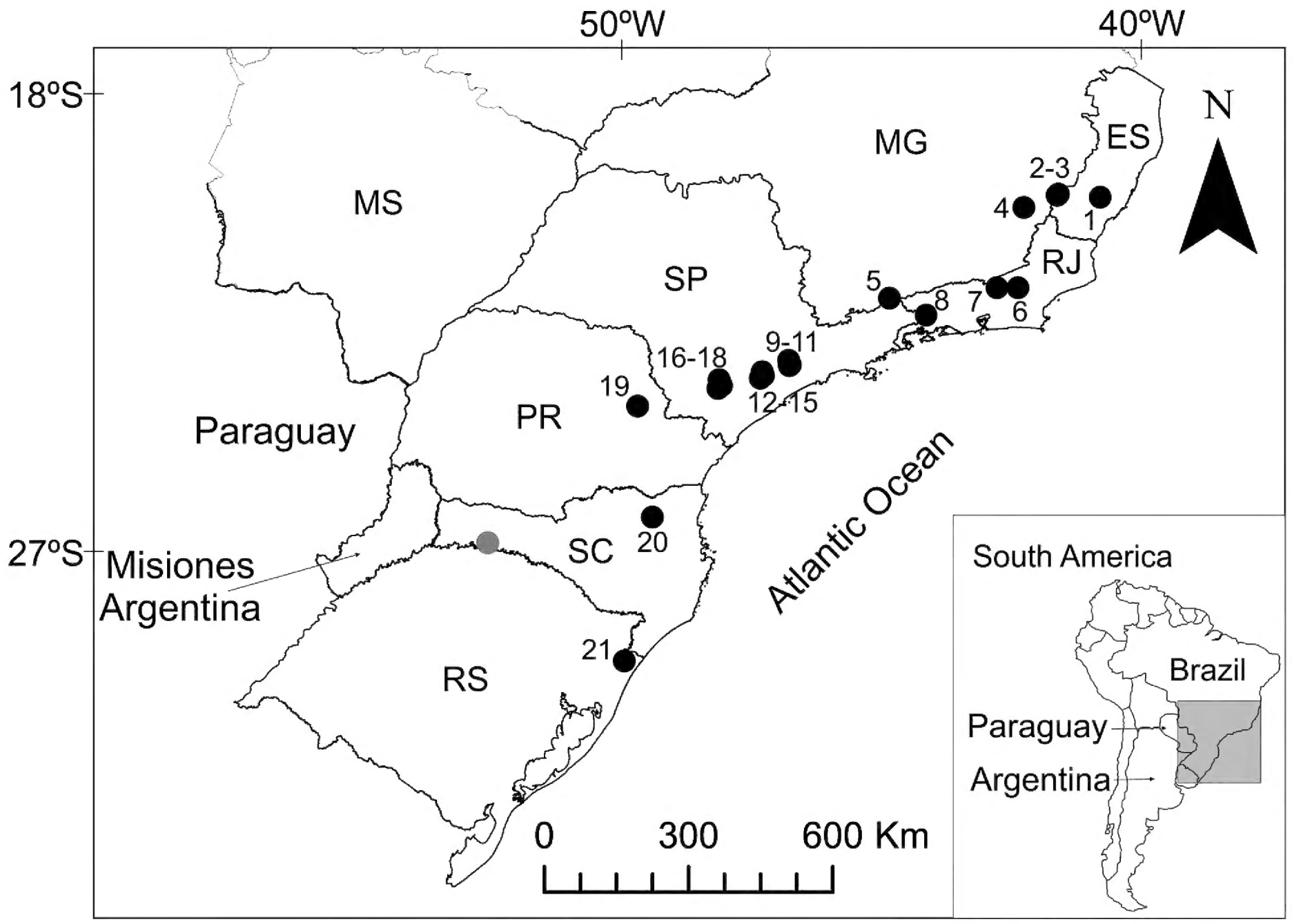

Figure 1. Map of sampling localities of *Juliomys ossitenus* with the new record in red (–27.0586, –052.6933). Previous known localities were obtained from literature (Costa et al. 2007; Pavan and Leite 2011; Aguieiras et al. 2013; Grazzini et al. 2015; Christoff et al. 2016). Espírito Santo: 1. Castelo, Parque Estadual do Forno Grande (–20.52, –041.00); 2. Dores do Rio Preto, Casa Queimada, Parque Nacional do Caparaó (–20.46, –041.81); 3. Macieira, Parque Nacional do Caparaó (–20.48, –041.83). Minas Gerais: 4. Fervedouro, Fazenda Neblina, Parque Estadual da Serra do Brigadeiro (–20.72, –042.48); 5. Passa Quatro, Fazenda do Itaguaré (–22.47, –045.08). Rio de Janeiro: 6. Teresópolis, Parque Nacional da Serra dos Órgãos, Abrigo Paquequer (–22.27, –042.59); 7. Parque Nacional da Serra dos Órgãos, Rancho Frio (–22.27, –043.00). São Paulo: 8. Bananal, Estação Ecológica do Bananal (–22.80, –044.37); 9. Cotia, Sítio Até Que Enfim, Caucaia do Alto (–23.68, –047.03); 10. Quilombo, Reserva Florestal do Morro Grande, Caucaia do Alto (–23.76, –047.00); 11. Grilos, Reserva Florestal do Morro Grande (–23.78, –47.01); 12. Piedade, Cristo (–23.85, –047.47); 13. Fragmento Eme (–23.88, –047.48); 14. Tapiraí, Fragmento Antenor (–23.92, –047.45); 15. Janzinho (–23.97, –047.51); 16. Ribeirão Grande, Mulheres (–24.05, –048.37); 17. Museros (–24.22, –048.40); 18. Mina Limeira (–24.17, –048.33). Paraná: 19. Piraí do Sul, Floresta Nacional de Piraí do Sul (–24.56, –049.95). Santa Catarina: 20. Dr. Pedrinho, Reserva Biológica Estadual de Sassafrás (–26.71, –049.66). Rio Grande do Sul: 21. São Francisco de Paula, Centro de Pesquisas e Conservação da Natureza Pró–Mata (–29.49, –050.21).

Methods

The study was conducted in the municipality of Chapecó, west of Santa Catarina, in a transitional region between the phytophysiognomies of Seasonal Deciduous and Mixed Ombrophilous forests, inside the Atlantic Forest domain (about 600 m alt.; IBGE 2011). The climate is defined as temperate oceanic type according to Köppen climate classification (Peel et al. 2007), characterized by humid mesothermic with annual average temperatures ranging between 18 °C and 19 °C and an annual average rainfall of 1,800 mm. Rainfall is equally distributed throughout the year. Historically, the region has suffered significant anthropogenic change, with the dominance of monocultures and a consequent highly fragmented landscape.

We sampled small mammals in six forest fragments between June 2016 to December 2016. Twenty Tomahawk standard traps of one size (12 × 12 × 25 cm) were installed in 10 sample points in each fragment (two traps per point), distant at least 20 m between each other. Each fragment was sampled for 20 days along the sample period. Traps were baited with a mixture of peanut butter, mashed bananas and sardines applied to a slice of maize.

The captured animals were identified in the field, and some were taken to the laboratory where they were submitted to cytogenetic analysis following the standard protocol of Ford and Hamerton (1956). The specimens, preserved as skin and skull, and their respective tissue samples are deposited in the Mammal Collection at the Zoology Laboratory of the Federal University of the Southern Border, Campus Realeza. The study was conducted under license of the National System of Biodiversity Information (SISBIO; number 52837–1). All procedures involving capture and handling the animals were approved by the Institutional Animal Care and Use Committee of the Community University of Chapecó Region (protocol 004–2016). This study was conducted following the recommendations of the American Society of Mammalogists (Sikes et al. 2011).

Results

New records. BRAZIL• 2 adults ♂; Santa Catarina state, municipality of Chapecó; −27.0586, −052.6933; 706 m alt.; 16 June 2016; M. Souza and D. Galiano leg; DG037, DG038.

The two individuals were captured in the same sample point in a small forest fragment (area less than 10 hectares). Other small mammals were also registered during the sampling campaigns: *Akodon montensis* Thomas, 1913 ($n = 26$), *Gracilinanus microtarsus* (Wagner, 1842) ($n = 5$), *Monodelphis dimidiata* (Wagner, 1847) ($n = 1$), *Oligoryzomys flavescens* (Waterhouse, 1837) ($n = 1$), and *O. nigripes* (Olfers, 1818) ($n = 4$).

Identification. The identification at genus level was based on external morphological characteristics: short pelage, dark oranges dorsum, cream–white belly with markedly oranges portions of the snout and haunches, and small body size (Costa et al. 2007; Bonvicino et al. 2008). The vouchers present orange–tipped hairs visible in the inguinal region around the tail base, and ungual tufts grayish–white, reaching or slightly surpassing the claws. Confirmation of the species was made by karyotype examination (Fig. 2). The external and craniodental measurements are presented in Table 1, and views of the skull and skin are shown in Figure 3. The karyotype shown by both individuals was 2n = 20 and FN = 36 (10 cells counted). All the autosomes are bi–armed, varying between metacentric and submetacentric. The sexual pair has a metacentric X chromosome and a large acrocentric Y chromosome, as previously described by Costa et al. (2007).

Discussion

This study reports a record of two individuals of *Juliomy ossitenuis* in the state of Santa Catarina, in a fragment of Deciduous Seasonal Forest, representing the westernmost record of the species in Brazil. The present record increases its distribution about 300 km eastward from the nearest record (Christoff et al. 2016). This is the most westerly record in this type of physiognomy, characterized by the transition between deciduous and Araucaria forests. The sampled fragment possesses vegetation elements from both physiognomies: the deciduous forest presents foliar seasonality of the dominant arboreal elements, whose percentage of leaf fall is 50% or more in the colder months; and the Araucaria forest presents the typical Araucaria pine, *Araucaria angustifolia* (Bert.) (Silva–Filho and Pugues 2008). Furthermore, by analyzing other records of the genus *Juliomys*, it is possible to verify that this new record is geographically closer to *J. pictipes* in the Parque Provincial Ernesto Che Guevara (Caraguatay, Argentina; ~230 km), and Reserva Privada de Usos Múltiples de la Universidad Nacional de La Plata, Valle del Arroyo Cuza Pirú (Misiones, Argentina; ~220km) (Pardiñas et al. 2008), than to other records of *J. ossitenuis* in Brazil: 300 km from São Francisco de Paula (Rio Grande do Sul; Christoff et al. 2016), and 390 km from Floresta Nacional de Piraí do Sul (Paraná; Grazzini et al. 2015). This new record supports the information of Christoff et al (2016) where they indicate that *J. ossitenuis, J. pictipes* and *J. ximenezi*might occur in sympatry. Besides, the proximity of this new record with

Figure 2. Karyotype of an adult male of *Juliomys ossitenuis* sampled in Chapecó, Santa Catarina, with 2n = 20, FNa = 36.

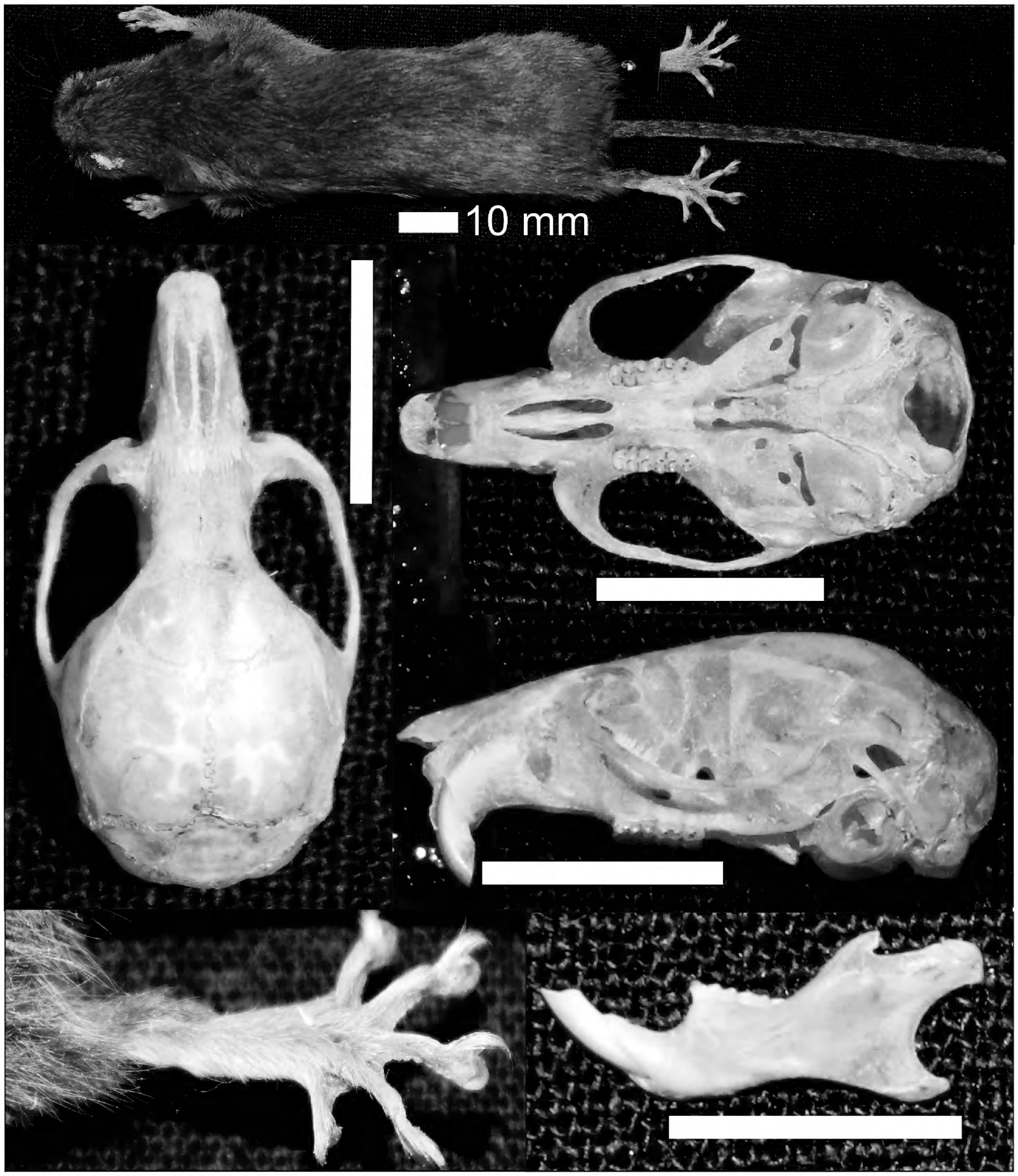

Figure 3. *Juliomys ossitenus* adult male DG038 collected in Chapecó, Santa Catarina state, southern Brazil. Dorsal view of the skin. Dorsal, ventral, and lateral views of the skull. On the bottom, left photo, details of the foot covered by orangish-brown hair. On the bottom right, lateral view of the mandible. Scale bars: 10 mm.

Misiones in Argentina may indicate that sympatry might occur in other parts of the species distributions. Moreover, our results highlight the importance of small fragments in maintaining the diversity of small mammals.

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Table 1. External and craniodental measurements (mm) and weight (g) of two *Juliomys ossitenuis* specimens caught at Chapecó, Santa Catarina, Brazil, and of the holotype and two paratypes, extracted from Costa et al. (2007). Abbreviations: BCB = braincase breadth; BIT = breadth across incisor tips; BL = bullar length; BW = bullar width; DL = diastema length; DR = depth of ramus; Ear = length of ear; GLM = greatest length of mandible; HF = hind foot length; IFB = incisive foramen breadth; IFL = incisive foramen length; IOB = interorbital breadth; M1B = first molar breadth; MFB = mesopterygoid fossa breadth; MMR = mandibular molar row–alveolar length; MRC = molar row crown length; NL = nasal length; ONL = occipto–nasal length; PB1 = palatal breadth at first molar; PB3 = palatal breadth at third molar; PBL = palatal bridge length; PL = palatal length; PPL = post–palatal length; RB = rostral breadth; RH = rostral height; RL = rostral length; SH=skull height; TA = length of tail; TFL = temporal fossa length; TL = total length; ZB = zygomatic breadth; ZPL = zygomatic plate length.

	DG037 (M)	DG038 (M)	MN 69752 Holotype (F)	MZUSP 33170 Paratype (F)	UFMG 3174 Paratype (M)	Mean
Age	2	2	3	3	2	–
TL	157	185	205	177	165	177.80
TA	76	95	110	103	89	94.60
HF	19	17	21	19	14	18.00
Ear	12	12	16	10	14	12.80
Weight	18	18	22	14	11	16.60
ONL	24.04	24.65	25.74	23.95	21.95	23.88
PL	9.25	8.80	11.61	10.81	9.80	10.74
PPL	8.13	8.50	9.01	8.32	7.47	8.27
MRC	3.63	3.74	3.85	3.65	3.76	3.75
M1B	1.08	1.09	1.06	1.02	1.03	1.04
PBL	3.44	3.61	3.81	3.39	3.28	3.49
TFL	7.07	7.20	7.84	6.56	6.79	7.06
DL	6.19	5.75	6.57	6.01	5.47	6.02
IFL	4.11	4.22	4.85	4.72	4.19	4.59
IFB	1.44	1.46	1.78	1.34	1.69	1.60
PB1	2.43	2.31	2.57	2.31	2.33	2.40
PB3	2.72	2.61	2.86	2.63	2.69	2.73
MFB	1.41	1.68	1.86	1.72	1.43	1.67
BIT	1.64	1.70	1.65	1.57	1.31	1.51
BW	3.72	3.83	3.79	3.70	3.71	3.73
BL	4.17	4.14	4.78	4.48	4.62	4.63
BCB	10.44	10.28	10.12	10.34	10.15	10.20
SH	7.77	7.62	7.54	7.33	6.95	7.27
RH	4.50	4.39	4.68	4.22	3.99	4.30
RB	4.18	4.28	4.33	3.90	3.74	3.99
RL	6.66	6.76	7.90	7.42	6.35	7.22
NL	9.13	9.90	9.15	8.95	7.23	8.44
ZPL	2.09	1.88	1.77	1.66	1.34	1.59
IOB	3.65	3.58	3.63	3.87	3.69	3.73
ZB	12.97	12.77	13.27	12.19	11.97	12.48
GLM	12.31	11.75	13.37	12.51	11.76	12.55
MMR	3.63	3.64	3.95	3.72	3.77	3.81
DR	2.81	2.63	2.81	2.71	2.63	2.72

Authors' Contributions

All authors contributed to the study conception and design. MMS, BBK, RK, and DG sampled the data and made the cytogenetics. MMS, RM, and DG made the morphological measurements. All authors wrote the text.

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